

# Evaluation of Flavored Cigar Products As They Relate To Questions of Public Health

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## Research Article

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1 **Evaluation of flavored cigar products as they relate to questions of**  
2 **public health**

3

4 **Short title:** Flavored cigars and questions of public health

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11 **Abstract**

12 **Background:** Flavors in tobacco products is a subject of public health debate and increasing  
13 regulatory attention. There is interest in gaining an in-depth understanding of flavored cigar  
14 smoking prevalence and behaviors to address the use of flavors in cigars and questions of public  
15 health.

16 **Methods:** Seven publicly available data resources that assess flavored cigar use were analyzed.  
17 Two focus on youth tobacco use (NYTS, MTF), four focus on adult tobacco use (HINTS-FDA,  
18 NATS, TPRPS, TUS-CPS), and one on both groups (PATH). Available data (2011-2019) were  
19 analyzed to assess usage trends over time. In addition, longitudinal analysis of PATH adult data  
20 examined whether flavored cigar use was associated with future use of cigarettes or increased  
21 use of cigars.

22 **Results:** Youth past 30-day estimates of cigar use ranged from 2%-10% for both flavored and  
23 non-flavored cigars, slightly higher in high school vs. middle school age subpopulations. These  
24 estimates have been stable or declined across all survey years within the respective surveys.  
25 Consistent trends were observed regarding frequency of use; most youth using cigars do so 1-2  
26 days per month.

27 Similar findings were observed for adult cigar users, with five surveys indicating less than 10%  
28 currently use cigars. Flavored cigar use is at less than 5% across all data sources. These  
29 overarching use estimates were essentially flat over time. Frequency of youth cigar use  
30 remained consistent over time, with most youth reporting cigar use on 1-2 days per month. In  
31 addition, multivariable modeling of PATH adult data did not identify an association between  
32 flavored cigar use and future use of cigarettes or increased use of cigars.

33 **Conclusions:** No evidence was found of increased use or different usage patterns, among either  
34 youth or adults, of flavored cigars vs. non-flavored cigars. While these trends should continue to  
35 be monitored, there is no indication of existing or emerging public health concerns related to  
36 flavored cigars within the seven large, nationally representative, US government-funded  
37 epidemiologic databases examined.

38 **Keywords**

39 Cigars, Flavors, Use Patterns, Public Health

## 40 **Background**

41 The issue of flavors in tobacco products has been the subject of intense public health debate and  
42 increasing regulatory attention. FDA has expressed concern about flavors in tobacco products and  
43 their potential effects on public health and, in March 2018, issued an Advance Notice of Proposed  
44 Rulemaking on this issue [1]. This sentiment was communicated again in their Draft Guidance  
45 Document from March 2019 that proposed modifying the August 2017 Compliance Policy for  
46 flavors in cigars [2]; however, ultimately FDA determined to not take enhanced enforcement  
47 action against flavored cigars at that time. Most recently, FDA announced an intention to release  
48 a Proposed Product Standard to Prohibit Characterizing Flavors in Cigars [3]. Due to this  
49 continuing regulatory interest, it is important to gain an in-depth understanding of flavored cigar  
50 smoking behaviors, prevalence, and use trajectories, as they relate to questions of public health.

51 Much of the recent published literature on flavored cigar use focuses on the impact of bans on  
52 flavored tobacco products, imposed at national [4] and local levels [5-7] over the past several  
53 years. Other studies have assessed potential abuse liability of flavored cigars [8, 9], and/or  
54 examined various associations and impacts of flavored non-cigarette tobacco product use in  
55 general (i.e., aggregating the use of flavored e-cigarettes, smokeless tobacco, hookah, pipe, and  
56 cigar products into a singular construct) [10-12]. Some studies continue to cite sometimes decade  
57 or older trends [13-15] and relatively few studies have reported on recent prevalence and use of  
58 cigars in general or flavored cigar products specifically. A 2019 systematic review of the literature  
59 on cigar research on youth echoed this sentiment in identifying flavored cigar research as an  
60 understudied domain [16].

61 To this end, we conducted a thorough investigation of federally funded, national databases focused  
62 on tobacco product use to assess cigar use, including flavored cigar use, prevalence and frequency

63 of use in U.S. youth and adults. The National Youth Tobacco Survey (NYTS), Population  
64 Assessment of Tobacco and Health Study (PATH), Health Information National Trends Survey  
65 (HINTS), Monitoring the Future (MTF), National Adult Tobacco Survey (NATS), Tobacco  
66 Product and Risk Perception Survey (TPRPS), and Tobacco Use Supplement to Current Population  
67 Survey (TUS-CPS) were identified as resources that assess not only cigar use overall, but also  
68 flavored cigar use specifically, in U.S. youth and/or adults. Here, we present findings from our  
69 analyses of these resources to identify similarities and differences in flavored versus non-flavored  
70 cigars as they relate to youth and adult use prevalence, smoking behaviors, and use trajectories  
71 including potential transition to combustible cigarette smoking or increased use frequency.

72 **Methods**

73 **Data Sources**

74 Several nationally representative epidemiologic surveys and studies were identified based on a  
75 review of medical and public health literature as well as online resources including the Inter-  
76 University Consortium for Political and Social Research (ICPSR), the Georgia State University  
77 Tobacco Portal; the Centers for Disease Control Office on Smoking and Health website, and a  
78 broad web-based search using key search terms related to cigar products and flavors. The seven  
79 identified publicly available data sources included cross-sectional collections of survey data and  
80 questions related to use of flavored cigar products. Table 1 provides a brief description of the  
81 population assessed and overarching content of each dataset.

82 Two of the identified resources focus on youth tobacco use (NYTS [17] and MTF [18]), four focus  
83 on adult tobacco use (HINTS-FDA [19, 20], NATS [21], TRPRS [22], and TUS-CPS [23]), and  
84 one collects survey results on both youth and adult tobacco users (PATH [24]). Notably, the Youth  
85 Risk Behavior Surveillance System (YRBSS [25]), a long-established data resource on youth  
86 tobacco use, was not included in this analysis because it does not include questions that specifically  
87 address the use of flavored tobacco.

88 Datasets that included questions related to use of flavored cigars were acquired from each of the  
89 seven identified resources. Table 2 specifies the datasets, the dates that surveys were administered,  
90 and brief descriptions of data elements that were extracted for analysis. For all but the TRPRS,  
91 public use files were downloaded directly from the respective websites that provide access. The  
92 TRPRS data files were acquired via direct download after formally requesting access and entering

93 into a Data Sharing Agreement for the survey data and related materials from the Georgia State  
94 University Tobacco Center of Regulatory Science (TCORS).

95 In order to adjust appropriately for complex study design characteristics, such as stratification,  
96 clustering within primary sampling units, and oversampling, population and replicate weights (as  
97 available) were used in calculating all estimates presented herein. The weights also adjust for  
98 nonresponse as appropriate. Use of these weights is required to produce results that are nationally  
99 representative of the U.S. civilian, noninstitutionalized population.

## 100 **Measures**

101 *Cigar types.* The cigar category is diverse, with cigars varying in size, shape, and weight, being  
102 filtered or unfiltered, and considered premium hand-rolled, or more economical machine-made  
103 cigars. The various surveys refer to cigars, and therefore collect data on their use, in somewhat  
104 different manners. Most surveys do not specify the category of cigar with extensive granularity in  
105 their questioning and tend to ask about cigar usage in a more general manner. Certain surveys,  
106 however, offer sets of questions specific to larger cigars versus smaller cigars. For example, PATH  
107 Study participants report separately whether they used filtered cigars, cigarillos, and/or traditional  
108 cigars (i.e., large cigars), with the PATH questionnaire displaying a photo of example products,  
109 describing their physical characteristics, and listing popular brands. Researchers have also  
110 attempted to stratify the large cigar category into premium and non-premium subtypes using price  
111 per unit and/or respondent-provided brand name information [26, 27]. Doing so, however,  
112 introduces potential complications related to recall error/inconsistency that can raise questions  
113 regarding estimate accuracy and validity.

114 For simplicity, the analyses generally consider cigar usage in the overall sense, without  
115 stratification into subtypes. One exception to this paradigm is in the MTF survey, which asks  
116 questions about use of flavored little cigars and cigarillos separately from use of “regular” little  
117 cigars and cigarillos. A third large cigar category is also considered. This three-group  
118 stratification presents challenges in separating flavored cigar use from cigar use in general. As  
119 such, the three categories are summarized separately. In all other surveys, use of flavored cigars  
120 is queried separately from use of cigars in general. This split enables investigation of possible  
121 differences in overall cigar usage versus usage of flavored cigars, without further complicating  
122 matters by introducing product subtypes.

123 One additional instance in which cigar usage data were not aggregated is represented in the  
124 longitudinal analyses of PATH. Here, data were retained in their standard form, stratified into the  
125 three PATH cigar categories (cigarillos, filtered cigars, traditional cigars) due to challenges related  
126 to combining validly results from the relevant survey questions required to conduct the  
127 corresponding analyses.

128 ***Cigar use.*** Cigar use is defined in various ways in the data sources considered. Current use by  
129 adults is defined in PATH as those who currently used the cigar type “every day” or “some  
130 days”. Other surveys report on use “now” or in the past 30 days. Current use for youth tends  
131 to be defined differently and requires only past 30-day use of cigars. In all cases, the respective  
132 Results subsections and corresponding figure and table descriptions use precise terminology  
133 to align with the language used in the survey.

134 ***Cigarette use.*** Current adult users of cigarettes are identified in the PATH Study as currently using  
135 cigarettes “every day” or “some days.” A minimum level of lifetime use ( $\geq 100$  cigarettes) is also

136 required for current established cigarette users. Current use of cigarettes by youth is defined  
137 somewhat differently in PATH by requiring only past 30-day use of any frequency.

### 138 **Analyses**

139 Analyses included adult and youth current users of cigars (typically in aggregate, although in some  
140 circumstances stratified into broad subtypes). Analyses of each cigar type were not mutually  
141 exclusive in that participants could be users of multiple cigar types.

142 We conducted analyses separately for each survey using R 3.4.0 [28] and the *survey* package [29,  
143 30] to generate weighted estimates to represent the US civilian, non-institutionalized adult (18+)  
144 and youth (12-17) populations. Where appropriate (e.g., PATH), estimated standard errors and  
145 95% confidence intervals (CIs) were calculated using the balanced repeated replication method  
146 [31] with Fay’s adjustment set to 0.3 to increase estimate stability [32] as recommended in survey  
147 data user guide documentation.

148 For PATH, cross-sectional analyses used weights corresponding to the appropriate wave and  
149 weight type (i.e., single wave weights for Waves 1-3 and cross-sectional weights for Wave 4).  
150 Longitudinal analyses used the predicted wave weights in accordance with PATH Study  
151 recommendations and multivariable logistic regression to examine associations between flavored  
152 cigar use and future product use behavior. Adjusted analyses controlled for sex (male, female),  
153 age, race/ethnicity (White, non-Hispanic; Black, non-Hispanic; Other, non-Hispanic; Hispanic),  
154 and education (less than high school, General Educational Development [GED], high school, some  
155 college or associate’s degree, bachelor’s degree or more advanced degree). This approach follows  
156 that used by Persoskie and colleagues in their study of cigar package quantity and pricing on  
157 smoking behavior [27]. Missing data on these variables were not imputed. So-called “imputed”

158 versions of demographic variables were used where available. These variables typically make  
159 reasonable inferences based on other PATH Survey documentation to make assignments for  
160 otherwise missing sex, age, or race/ethnicity variables, for example.

161 **Results**

162 **Youth Cigar Use**

163 *Current youth use trends over time.* Cigar usage estimates for the United States youth population  
164 are generally similar based on NYTS, PATH, and MTF data. Past 30-day estimates of cigar use  
165 overall tend to be approximately 2%-10% overall or for flavored cigars specifically, slightly higher  
166 in older relative to younger subpopulations. These estimates have remained generally stable or  
167 declined across all survey years within the respective surveys.

168 Figure 1 shows youth usage of cigars overall and for flavored cigars specifically across all analyzed  
169 survey years for NYTS and PATH. NYTS estimates of past 30-day use (on at least one day)  
170 between 2011 and 2013 were consistent indicating that approximately 8% of the United States  
171 youth population used cigar products at least once in the past 30 days. A notable shift occurred in  
172 2014 when estimates dropped to approximately 5% with estimates remaining essentially stable at  
173 that level through the most recently available survey year in 2019. This trend appears to be driven  
174 largely by the high school subpopulation (approximately 12% past 30-day use from 2011-2013,  
175 dropping to approximately 7.5% from 2014-2019), whereas middle school estimates were  
176 essentially flat or slightly declining throughout (approximately 3.5% in 2011 to approximately  
177 2.5% in 2019).

178 The NYTS trend over time for past 30-day flavored cigar use is more volatile, largely due to  
179 changes to the corresponding question between survey years. In survey years 2011 and 2013,  
180 respondents were asked only about use of flavored little cigars, and in 2012, respondents were  
181 asked only about use of flavored tobacco products in general. It should also be noted that the  
182 flavored cigar use question was not asked only of individuals indicating past 30-day cigar use, but

183 instead of all survey participants. Past 30-day flavored cigar users, therefore, should not be  
184 interpreted as reflecting a true subset of NYTS participants indicating past 30-day cigar use.

185 Recognizing some estimate instability early in the time course, estimates for past 30-day use of  
186 flavored cigars among United States youth overall have declined steadily from a high of  
187 approximately 5% in 2015 to approximately 3% in 2019. This trend again appears to be driven by  
188 the high school population (declining from a high of over 7.5% in 2015 to just over 4% in 2019),  
189 with middle school estimates remaining generally stable at approximately 1.5% from 2011-2019.

190

191 Youth usage of any cigars based on PATH data from Wave 1 (collected 2013/14) through Wave  
192 4 (collected late 2016 through early 2018) followed a similar trend to NYTS (Figure 1).

193 Estimates of past 30-day cigar use in youths overall declined from Wave 1 (approximately 2.5%)  
194 through Wave 3 and remained stable at approximately 1.5% through Wave 4. Use of flavored  
195 cigars has followed a similar trend falling from approximately 2% in Wave 1 to approximately  
196 0.5% in Wave 4. As observed in NYTS, these trends appear driven by the high school age 15–  
197 17-year subpopulation that tracks the overall trend with slightly higher estimates, with the middle  
198 school age 12–14-year subpopulation estimates remaining at consistent low levels across Waves  
199 1 through Wave 4 (approximately 0.5% overall and approximately 0.25% for flavored cigar use  
200 specifically).

201 MTF structures its cigar-related questions differently and does not assess flavored cigars  
202 generally. Rather, MTF asks more targeted questions focused on recent use of flavored little  
203 cigars or cigarillos, regular (i.e., non-flavored) little cigars or cigarillos, and large cigars,  
204 separately. The three usage groups are not mutually exclusive, and some respondents are

205 represented in multiple subgroups. Estimates of youth use of flavored little cigars or cigarillos in  
206 MTF have declined somewhat for 12<sup>th</sup> graders from approximately 12% in 2014 to less than 9%  
207 in 2018 (Figure 2). A more modest declining trend was similarly observed for 10<sup>th</sup> and 8<sup>th</sup>  
208 graders. Declining trends were likewise observed for all MTF youth subgroups for regular little  
209 cigars or cigarillos and large cigars.

210 ***Frequency of youth use*** Current cigar usage in these surveys only requires only affirmative  
211 indication of any use in the past 30 days; in other words, use on one day is counted the same as  
212 use on every day in the past month. To better understand usage patterns, the frequency of use in  
213 the past month was examined for NYTS and MTF among past 30-day cigar users overall and when  
214 limited to flavored cigar users only, respectively. Consistent trends were again observed with the  
215 majority of past 30-day youth users limiting cigar use to 1-2 days per month with another  
216 approximately 20% of past 30-day youth users limiting cigar use to 3-5 days. Further, overall youth  
217 estimates are generally similar to those from both high school and middle school past 30-day cigar  
218 using subpopulations. These trends hold across all survey years examined for overall or flavored  
219 cigar use in NYTS (Figure 3) and across the three cigar product categories assessed in MTF (Figure  
220 4).

## 221 **Adult Cigar Use**

222 ***Current adult use trends over time.*** Cigar usage estimates for the United States adult population  
223 are generally similar based on the five epidemiologic data sources analyzed. Despite slight  
224 differences in how current cigar use is defined across the respective surveys, all surveys indicate  
225 that less than 10% of adults currently use cigars of any type. Flavored cigar use estimates are  
226 similarly consistent at less than 5% across all data sources examined. Further, while estimates

227 vary somewhat between data collections within respective surveys, these overarching use  
228 estimates are essentially flat over time.

229 Figure 5 shows adult usage of cigars overall and for flavored cigars specifically, across all analyzed  
230 survey years for NATS, PATH, and the TPRPS. NATS estimates for the adults who use cigars  
231 rarely, some days or every day were essentially unchanged from 2009/10 through 2013/14  
232 (approximately 7% of United States adults overall). Estimates of past 30-day flavored cigar use  
233 are similarly consistent over time at approximately 2.5% from 2009/10 through 2013/14. PATH  
234 estimates were similar for current established adult users of cigars in the United States with Wave  
235 1 (collected 2013/14) through Wave 4 (collected 2016/18) estimates generally stable at  
236 approximately 3%. Past 30-day flavored cigar use among adults in the United States were also  
237 consistent at approximately 2% across Waves 2 through 4 (Wave 1 did not include specific  
238 flavored cigar use questions). TPRPS estimates of past 30-day adult use (even one or two puffs)  
239 of traditional cigars, cigarillos, filtered or little cigars varied between 4% in 2014 to nearly 7  
240 percent in 2017 without a clear direction in trend. A similar pattern for past 30-day use of flavored  
241 cigars was observed between 2015 and 2017 (the 2014 survey did not ask specifically about past  
242 30-day flavored cigar use). Only respondents indicating recent use of little cigars, cigarillos, or  
243 filtered cigars were asked about flavored cigar use, with estimates varying between approximately  
244 2% in 2015 and approximately 2.5% in 2017 also without a clear discernible direction in trend.

245 The two respective sets of data analyzed for HINTS-FDA and TUS-CPS yielded similar findings  
246 (Supplementary Figure 1). HINTS-FDA current (every day or some days) cigar use estimates  
247 among American adults showed a somewhat declining trend, from approximately 5% in 2015 to  
248 approximately 4% in 2017, although with largely overlapping confidence intervals. HINTS-FDA  
249 estimates of past 30-day use of flavored tobacco products among current (every day or some day)

250 cigar users were essentially flat at 5% (the survey questions were structured such that current non-  
251 flavored cigar users who use other non-cigar, flavored tobacco products could be counted among  
252 this subgroup). TUS-CPS estimates of current adult use (every day or some days) of regular cigars,  
253 or cigarillos, or little filtered cigars were stable at approximately 2% based on data collected in  
254 2014-2015 and 2018. A similar pattern for current users of cigars that usually use flavored cigar  
255 products was observed with estimates stable at less than 0.5%.

256 ***Frequency of adult use.*** Consistent trends were likewise observed when more closely examining  
257 the frequency of use among adult cigar users. A relatively small proportion are every day cigar  
258 users and the most commonly reported use pattern is 1-2 days per month for surveys with  
259 sufficiently granular information on use frequency. These trends have held stable across several  
260 data sources and over time.

261 TUS-CPS and TPRPS past 30-day frequency of use was examined for cigar users overall and when  
262 limited to flavored cigar users only (Figure 6). Consistent trends were observed across data  
263 collections with the majority of cigar users indicating use on 1-2 days or 3-5 days. Less than 5%  
264 of users indicated use on 20+ days or more per month in the TUS-CPS, whereas TPRPS estimates  
265 were somewhat higher at approximately 15-20% in all data collection years except for 2015. These  
266 trends hold for both overall and flavored cigar use only.

## 267 **Flavored Cigar Use and Other Tobacco Use Behavior**

268 ***Flavored Cigar Use and Subsequent Cigarette Use.*** In addition to the cross-sectional analyses of  
269 PATH data described previously, longitudinal analyses were conducted using weighted logistic  
270 regressions to test whether prior use of flavored cigars predicted becoming an established cigarette  
271 smoker in adult cigar users who did not smoke cigarettes in the prior wave. Analyses considered

272 cigarillo, filtered cigar, and traditional cigar categories separately as defined and coded in PATH.  
273 Flavored cigar use was established based on the respective survey questions that inquired about  
274 past 30-day use of such products. Valid responses were “Yes”, “No”, and “I don’t know”, and the  
275 primary question of interest was whether those individuals responding “Yes” were more or less  
276 likely than individuals responding “No” to become established cigarette users in the subsequent  
277 wave.

278 Table 3 reports results from analyses that assessed subsequent wave cigarette smoking status  
279 among prior wave non-cigarette smoking cigar using respondents who indicated whether or not  
280 there was past 30-day flavored cigar use. A similar Wave 1/Wave 2 analysis was not conducted  
281 because past 30-day use of flavored cigars was not assessed in Wave 1.

282 The prevalence of Wave 3 established cigarette smokers ranged from approximately 5% to  
283 approximately 25% across Wave 2 cigar type and flavored subgroups (top Table 3). Filtered  
284 cigar users reporting past 30-day flavored filtered cigar use had the highest prevalence with  
285 cigarillo and traditional cigar users having similar, lower prevalence of Wave 3 established  
286 cigarette smoking. A Wave 3/Wave 4 analysis yielded similar findings (bottom Table 3).

287 No statistically significant results were obtained from comparisons designed to determine if prior  
288 wave past 30-day flavored cigar use among non-cigarette smokers influenced established  
289 cigarette smoking status in the subsequent wave. The consistent lack of statistically significant  
290 findings suggests that flavored cigar use among non-cigarette smokers was not found to be  
291 associated with becoming an established cigarette smoker in the future. It should be noted,  
292 however, that the PATH data indicate that such a transition is a rare event among cigar users  
293 with a limited number of records available for analysis (see Record Count column in Table 3).

294 As such, this pattern of product use should continue to be monitored with future data collections  
295 and estimates based on ten or fewer records interpreted cautiously.

296 ***Flavored Cigar Use and Frequency of Subsequent Use.*** In a separate set of longitudinal analyses,  
297 the transition to increased frequency of use was assessed. Specifically, weighted logistic  
298 regressions also were used to evaluate whether prior flavored cigar use predicted progression from  
299 regular but non-daily use to daily use among established adult cigar users (i.e., some day to every  
300 day use). In addition, a conceptually similar analysis assessed whether flavored cigar use predicted  
301 progression from regular but non-daily use to cessation (i.e., some day to non-current use). As in  
302 the prior section, analyses considered cigarillo, filtered cigar, and traditional cigar categories  
303 separately as defined and coded in PATH. Also similar to the previously discussed longitudinal  
304 analysis, flavored cigar use was established based on the respective survey questions that inquired  
305 about past 30-day use of such products. Valid responses were “Yes”, “No”, and “I don’t know”,  
306 and the primary question of interest was whether those some day cigar users responding “Yes”  
307 were more or less likely than those responding “No” to become an every day cigar user in the  
308 subsequent wave, or, alternatively, a non-current cigar user in the subsequent wave.

309 Table 4 reports analytic results focused on the transition from regular but nondaily cigar use to  
310 daily cigar use between Waves 2 and 3. Among Wave 2 non-daily established users of all cigar  
311 types and prior flavored cigar use subgroups, progression to daily cigar use was infrequent.  
312 Approximately 13% of filtered cigar users progressed to daily use, with cigarillo and traditional  
313 cigar users doing so to a lesser extent (see Prevalence column of Table 4). Prevalence estimates  
314 were generally similar whether or not prior use of flavored cigars was indicated with no statistically  
315 significant findings identified. As in the analysis of transition to established cigarette use,  
316 however, the PATH data indicate that transition to everyday cigar use is a rare event with a limited

317 number of records available for analysis (see Record Count column in Table 4). As such, this  
318 pattern of product use should continue to be monitored with future data collections and estimates  
319 based on ten or fewer records interpreted cautiously.

320 The transition from some day cigar use in Wave 2 to non-current use in Wave 3, (i.e., cessation)  
321 was more common. Approximately 50% of Wave 2 cigarillo and filtered cigar users no longer  
322 indicated established cigar use in Wave 3, with essentially no difference identified between  
323 Wave 2 flavored versus non-flavored cigar users. Cessation among traditional cigar users was  
324 less common with approximately 28% and 14% of Wave 2 flavored and non-flavored cigar  
325 users, respectively, no longer indicating established use in Wave 3. Interestingly, a statistically  
326 significant difference was identified in an unadjusted analysis indicating Wave 2 flavored cigar  
327 users were more likely to cease use of traditional cigar products than Wave 2 users of non-  
328 flavored cigars (OR: 2.35, 95%CI:1.30-4.27). The statistically significant difference is not  
329 retained in a similar multivariable analysis adjusting for sex, age, race/ethnicity, and education  
330 (AOR: 1.28, 95%CI: 0.58-2.80), with apparent confounders of increased age and more advanced  
331 education associated with lower likelihood of cessation in Wave 3.

332 Results from a conceptually equivalent analysis of transition in cigar use frequency between Wave  
333 3 and Wave 4 are shown in Table 5. Findings were consistent with those from the Wave 2/Wave  
334 3 analysis. Progression to daily use was infrequent (approximately 10% for filtered cigar,  
335 somewhat less frequent for cigarillo, and less still for traditional cigar users) and no statistically  
336 significant differences were identified based on prior use of flavored cigars. In addition, transition  
337 from some day use in Wave 3 to non-current use in Wave 4 was similarly more common. A  
338 statistically significant difference was again observed in an unadjusted analysis of Wave 4  
339 traditional cigar users indicating increased likelihood of cessation for individuals using flavored

340 traditional cigar products in the prior Wave 3 (OR: 2.06, 95%CI: 1.08-3.96). However, the  
341 statistically significant finding again was not retained after adjusting for sex, age, race/ethnicity,  
342 and education in a multivariable model (AOR: 1.28, 95%CI: 0.55-2.96). Education level attained  
343 appears to be the primary confounder in this model, with more advanced education associated with  
344 lower likelihood of cessation in Wave 4.

345 ***Flavored Cigar Use and Youth Cigarette Use.*** The PATH youth data also enables longitudinal  
346 analysis in which tobacco use behavior can be assessed over time. For example, the likelihood  
347 of cigarette initiation based on prior use of flavored cigars can be assessed by integrating  
348 information for individuals across PATH waves (similar to that previously described in the prior  
349 subsections using PATH adult data). To do so, however, requires sufficient data records across  
350 waves.

351 As detailed in Table 6, with the exception of Wave 1 cigarillo use, data records on youth use of  
352 cigars are limited, thus restricting the types of analyses that can be conducted to assess whether  
353 use of flavored cigars is associated with subsequent initiation of cigarette use or other public  
354 health-relevant behaviors. Simple assessments of prevalence within individual waves are  
355 possible, but more complex cross-wave analyses will not yield robust results due to data  
356 limitations. Under these circumstances, even prevalence assessments are of limited value. The  
357 wide confidence intervals for dual use of cigarettes and flavored or unflavored cigars presented  
358 in Table 6 illustrate this point. The wide, overlapping confidence intervals, coupled with often  
359 unstable point estimates, complicate interpretation and preclude the development of firm  
360 conclusions. As such, data on these tobacco use behaviors should continue to be monitored, but  
361 conclusive findings await collection of considerably more information.

362 **Discussion**

363 After analyses of several outcomes across the various data sources, the results do not  
364 demonstrate an association between use of flavored cigar products and differential behaviors  
365 related to public health. Our findings with these large representative datasets were notably  
366 consistent among both youth and adult populations. Cigar usage estimates for the United States  
367 youth population are generally similar based on NYTS, MTF, and PATH with past 30-day  
368 estimates of cigar use between approximately 2%-10% overall or for flavored cigar products  
369 specifically. These estimates have remained generally stable or declined across all data  
370 collection years within the respective surveys. Consistent trends were likewise observed when  
371 looking at the frequency of use during the past 30 days. The majority of past 30-day youth users  
372 limit cigar use to 1-2 days per month with another approximately 20% of past 30-day youth users  
373 limiting cigar use to 3-5 days.

374 Similarly, analysis of NATS, HINTS, PATH, TUS-CPS, and TPRPS indicate that less than 10%  
375 of adults currently use cigars, and less than 5% currently use flavored cigars, indicating that  
376 flavored cigars continue to be an important product category to adult cigar users but with stable  
377 use prevalence over time. Also similar to the youth cigar use estimates, frequency of use per  
378 month estimates remained consistent across data sources and over time with the most commonly  
379 reported use pattern being 1-2 days per month, and only a relatively small proportion using  
380 cigars every day. In addition, longitudinal analysis of PATH adult data found that flavored cigar  
381 use was not differentially associated with future established use of traditional cigarettes or  
382 increased future use of cigars among regular but non-daily users. Data limitations precluded  
383 conducting the same analysis using PATH youth data.

384 Our findings related to current use metrics and corresponding daily use frequency echo those in a  
385 recent publication on tobacco product prevalence. Sánchez-Romero and colleagues detail  
386 variability in current use prevalence estimates in the context of various daily use thresholds (1+,  
387 10+, and 25+ days in the past 30 days) for various tobacco products across two of the surveys  
388 considered in this study (PATH and TUS-CPS) as well as the National Health Interview Survey  
389 (NHIS) [33]. They found differences in prevalence to vary least for cigarette and smokeless  
390 tobacco use across the daily use thresholds. In contrast, current use prevalence of other  
391 combustibles (cigars were grouped with hookah and pipe use) varied the most with increasing  
392 daily use thresholds and e-cigarette current use prevalence variation falling in between. The  
393 authors note that the large variation for other combustibles likely reflects their less stable usage  
394 pattern among primarily intermittent or social users. Further they note that a common definition  
395 of “current” use (e.g., use on one or more of the past 30 days) may not be an adequate single  
396 solution to assess/address tobacco use patterns and corresponding public health considerations.

397 Our work also touches on another potential issue with treating flavored tobacco products as  
398 monolithic. While our analyses did not identify a link between flavored cigar use and  
399 subsequent use behaviors of concern (i.e., cigarette smoking or increased cigar use), other studies  
400 have reported such associations [11, 34, 35]. Those studies, however, aggregated across flavored  
401 products such that flavored e-cigarette, flavored smokeless tobacco, and/or flavored cigar use are  
402 combined in a singular predictor of tobacco use behavior of concern. In contrast, a study of  
403 young adult college students that more specifically targeted use of flavored cigars found the  
404 number of days of cigar use and current use of other tobacco products were not associated with  
405 use of flavored cigars [36].

406 As such, while broad flavor bans may effectively restrict sales in the target localities [5],  
407 potential unintended consequences with public health relevance should be considered. For  
408 example, some evidence is emerging that cigarette smoking increased following the imposition  
409 of the flavored tobacco product ban in San Francisco [7, 37]. Additional unintended public  
410 health consequences could also include increasing use of after-market addition of unregulated  
411 and potentially unsafe flavor additives. In a study of e-cigarette users, the majority of  
412 participants reported their intent to circumvent potential FDA flavor restrictions via illicit  
413 sources or self-manufacture [38].

414 There are opportunities for future research to explore these and related topics. Many of these  
415 data resources collect a wide array of information on risk perception, reasons for smoking, and  
416 other potentially relevant public health information. Our analysis focused on current use overall,  
417 frequency of use, and trends over time with respect to those parameters. Other analyses are  
418 possible using a similar framework. In addition, data from many of these surveys (e.g., NYTS,  
419 MTF, PATH) will continue to be collected and released for analysis on an ongoing basis. As  
420 such, the analyses presented herein can be replicated with future data releases to continue to  
421 monitor these and potentially other relevant issues on an ongoing basis.

422 Several important considerations and potential limitations should be kept in mind when  
423 interpreting these findings. First, cigar misclassification is a well-recognized issue, even with  
424 surveys such as PATH [26, 27]. The photos presented to survey participants and detailed  
425 descriptions of each cigar type are designed to limit such problems, but some participants may still  
426 misclassify, for example, traditional/premium cigars and cigarillos, or vice versa. Further, brand  
427 misclassification [26, 27] has also been observed, with respondents occasionally reporting well  
428 known cigarette brands in response to questions about cigar use.

429 In addition, the weighted estimates are not intended to represent exact values. All estimates should  
430 be viewed in the context of their 95% confidence intervals and the number of individual survey  
431 subjects/records that underlie each estimate. While there is no firm guideline on the minimum  
432 number of records needed to provide a robust estimate, a common rule of thumb is for any  
433 estimates based on the low tens of records to be treated cautiously. This consideration is  
434 particularly relevant should additional stratification or statistical adjustment be required. Data  
435 limitations of this type can, and in some cases should, preclude the use of certain analytic methods.  
436 The longitudinal analyses of PATH should be interpreted carefully as several estimates were based  
437 on few records and corresponding estimates may be unreliable.

438 **Conclusions**

439 In conclusion, after assessing the most current, publicly available US public health datasets on  
440 tobacco use, we did not identify any indication that flavored cigar product use raises different  
441 questions of public health. The proportion of current users has remained low and stable or  
442 declining over time, and the pattern of use (rarely every day, and most often on very few days  
443 per month) has likewise remained stable in both youth and adult cigar using populations. No  
444 evidence was found of increased use or different usage patterns, either among youth or adults, of  
445 flavored relative to unflavored cigar products. The frequency of daily usage of cigars in general  
446 and flavored products specifically, has not increased during the study period, in either adults or  
447 youth. Further, no differences in prevalence of reported use were found specifically for flavored  
448 products. That is, neither adult nor youth users of any cigars, showed increases in use of flavored  
449 cigars concomitant with decreases in unflavored products. In addition, longitudinal analysis of  
450 PATH adult data failed to identify associations between flavored cigar use and subsequent use  
451 behaviors of potential concern (i.e., cigarette use initiation or increased cigar use).

452 Therefore, while these trends should continue to be monitored on an ongoing basis, there is no  
453 indication of existing or emerging public health concerns related specifically to flavored cigar  
454 products within the seven large, nationally representative epidemiologic databases examined for  
455 this study.

456 **List of abbreviations**

AOR	Adjusted Odds Ratio
CI	Confidence Interval
CTP	Center for Tobacco Products
FDA	Food and Drug Administration
GSU	Georgia State University
HINTS	Health Information National Trends Survey
ICPSR	Inter-University Consortium for Political and Social Research
MTF	Monitoring the Future
NATS	National Adult Tobacco Survey
NHIS	National Health Interview Survey
NIH	National Institutes of Health
NYTS	National Youth Tobacco Survey
OR	Odds Ratio
PATH	Population Assessment of Tobacco and Health Study
TCORS	Tobacco Center of Regulatory Science
TPRPS	Tobacco Product and Risk Perception Survey
TUS-CPS	Tobacco Use Supplement to Current Population Survey
YRBSS	Youth Risk Behavior Surveillance System

457

458 **Declarations**

459 **Ethics approval and consent to participate**

460 This study used public-use, de-identified, secondary data and, as such, is not considered human  
461 subjects research under 45 CFR 46.102; therefore, IRB approval was not required. The study was  
462 conducted and reported according to STROBE guidelines, and, as applicable, in accordance with  
463 the Declaration of Helsinki.

464 **Consent for publication**

465 Not applicable

466 **Availability of data and materials**

467 All data analyzed during this study are publicly available with data access details provided in Table  
468 2.

469 **Competing interests**

470 ARJ is a principal with Consilium Sciences, a company that provides consulting services on  
471 tobacco and nicotine, among other products, on a project basis to companies involved in tobacco  
472 harm reduction.

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475 Altria Client Services LLC, ITG Brands LLC, Swedish Match North America and Swisher  
476 International Inc.

477 **Authors' contributions**

478 ARJ determined the methodological approach and conducted and checked the analyses reported.  
479 Initial and final drafts of the paper were prepared by ARJ.

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487 for this study. However, we should note that information presented in this paper does not  
488 necessarily represent the official views of the Georgia State University, the GSU Tobacco Center  
489 of Regulatory Science research team, the NIH or the Food and Drug Administration.

490 **References**

491 1. **Advance Notice of Proposed Rulemaking, Regulation of Flavors in Tobacco**  
492 **Products, 83 Fed. Reg. 12,294 (March 21, 2018).**  
493 [[https://www.federalregister.gov/documents/2018/03/21/2018-05655/regulation-of-](https://www.federalregister.gov/documents/2018/03/21/2018-05655/regulation-of-flavors-in-tobacco-products)  
494 [flavors-in-tobacco-products](https://www.federalregister.gov/documents/2018/03/21/2018-05655/regulation-of-flavors-in-tobacco-products)]

495 2. **Modifications to Compliance Policy for Certain Deemed Tobacco Products; Draft**  
496 **Guidance for Industry, 84 Fed. Reg. 9345**  
497 [[https://www.federalregister.gov/documents/2019/03/14/2019-04765/modifications-to-](https://www.federalregister.gov/documents/2019/03/14/2019-04765/modifications-to-compliance-policy-for-certain-deemed-tobacco-products-draft-guidance-for-industry)  
498 [compliance-policy-for-certain-deemed-tobacco-products-draft-guidance-for-industry](https://www.federalregister.gov/documents/2019/03/14/2019-04765/modifications-to-compliance-policy-for-certain-deemed-tobacco-products-draft-guidance-for-industry)]

499 3. **FDA Commits to Evidence-Based Actions Aimed at Saving Lives and Preventing**  
500 **Future Generations of Smokers** [[https://www.fda.gov/news-events/press-](https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers)  
501 [announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-](https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers)  
502 [future-generations-smokers](https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers)]

503 4. Chaiton MO, Schwartz R, Tremblay G, Nugent R: **Association of flavoured cigar**  
504 **regulations with wholesale tobacco volumes in Canada: an interrupted time series**  
505 **analysis.** *Tob Control* 2019, **28**(4):457-461.

506 5. Kephart L, Setodji C, Pane J, Shadel W, Song G, Robertson J, Harding N, Henley P,  
507 Ursprung WWS: **Evaluating tobacco retailer experience and compliance with a**  
508 **flavoured tobacco product restriction in Boston, Massachusetts: impact on product**  
509 **availability, advertisement and consumer demand.** *Tob Control* 2020, **29**(e1):e71-e77.

510 6. Rogers T, Feld A, Gammon DG, Coats EM, Brown EM, Olson LT, Nonnemaker JM,  
511 Engstrom M, McCrae T, Holder-Hayes E *et al*: **Changes in cigar sales following**  
512 **implementation of a local policy restricting sales of flavoured non-cigarette tobacco**  
513 **products.** *Tob Control* 2020, **29**(4):412-419.

514 7. Yang Y, Lindblom EN, Salloum RG, Ward KD: **The impact of a comprehensive**  
515 **tobacco product flavor ban in San Francisco among young adults.** *Addict Behav Rep*  
516 2020, **11**:100273.

517 8. Bono RS, Cobb CO, Wall CS, Lester RC, Hoetger C, Lipato T, Guy MC, Eissenberg T,  
518 Bickel WK, Barnes AJ: **Behavioral economic assessment of abuse liability for Black**  
519 **& Mild cigar flavors among young adults.** *Exp Clin Psychopharmacol* 2020.

520 9. Wall CS, Bono RS, Lester RC, Hoetger C, Lipato T, Guy MC, Eissenberg TE, Bickel  
521 WK, Barnes AJ, Cobb CO: **Triangulating abuse liability assessment for flavoured**  
522 **cigar products using physiological, behavioural economic and subjective**  
523 **assessments: a within-subjects clinical laboratory protocol.** *BMJ Open* 2018,  
524 **8**(10):e023850.

525 10. Dai H, Hao J: **Flavored Tobacco Use Among U.S. Adults by Age Group: 2013-2014.**  
526 *Subst Use Misuse* 2019, **54**(2):315-323.

527 11. Farley SM, Seoh H, Sacks R, Johns M: **Teen use of flavored tobacco products in new**  
528 **York city.** *Nicotine Tob Res* 2014, **16**(11):1518-1521.

529 12. Villanti AC, Johnson AL, Ambrose BK, Cummings KM, Stanton CA, Rose SW, Feirman  
530 SP, Tworek C, Glasser AM, Pearson JL *et al*: **Flavored Tobacco Product Use in Youth**  
531 **and Adults: Findings From the First Wave of the PATH Study (2013-2014).** *Am J*  
532 *Prev Med* 2017, **53**(2):139-151.

- 533 13. Dunn DS, Johnson AL, Sterling KL, Cohn AM: **Differences in reasons for little**  
534 **cigar/cigarillo use across white and black/African American young adult users.**  
535 *Addict Behav* 2021, **118**:106884.
- 536 14. Lawyer GR, Jackson M, Prinz M, Lamb T, Wang Q, Muthumalage T, Rahman I:  
537 **Classification of flavors in cigarillos and little cigars and their variable cellular and**  
538 **acellular oxidative and cytotoxic responses.** *PLoS One* 2019, **14**(12):e0226066.
- 539 15. Trapl ES, Yoder LD, Frank JL, Borawski EA, Sattar A: **Individual, Parental, and**  
540 **Environmental Correlates of Cigar, Cigarillo, and Little Cigar Use Among Middle**  
541 **School Adolescents.** *Nicotine Tob Res* 2016, **18**(5):834-841.
- 542 16. Kong G, Creamer MR, Simon P, Cavallo DA, Ross JC, Hinds JT, Fishbein H, Gutierrez  
543 K: **Systematic review of cigars, cigarillos, and little cigars among adolescents:**  
544 **Setting research agenda to inform tobacco control policy.** *Addict Behav* 2019, **96**:192-  
545 197.
- 546 17. Office on Smoking and Health: **Methodology Report.** In: *2020 National Youth Tobacco*  
547 *Survey.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for  
548 Disease Control and Prevention, National Center for Chronic Disease Prevention and  
549 Health Promotion, Office on Smoking and Health; 2020.
- 550 18. Johnston LD, Miech RA, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME: **2020**  
551 **Overview, Key Findings on Adolescent Drug Use.** In: *Monitoring the Future National*  
552 *Survey Results on Drug Use, 1975-2020.* Ann Arbor, Michigan: Institute for Social  
553 Research, University of Michigan; 2021.
- 554 19. Nelson DE, Kreps GL, Hesse BW, Croyle RT, Willis G, Arora NK, Rimer BK,  
555 Viswanath KV, Weinstein N, Alden S: **The Health Information National Trends**  
556 **Survey (HINTS): development, design, and dissemination.** *J Health Commun* 2004,  
557 **9**(5):443-460; discussion 481-444.
- 558 20. Blake KD, Portnoy DB, Kaufman AR, Lin CJ, Lo SC, Backlund E, Cantor D, Hicks L,  
559 Lin A, Caporaso A *et al*: **Rationale, Procedures, and Response Rates for the 2015**  
560 **Administration of NCI's Health Information National Trends Survey: HINTS-FDA**  
561 **2015.** *J Health Commun* 2016, **21**(12):1269-1275.
- 562 21. Agaku IT, King BA, Husten CG, Bunnell R, Ambrose BK, Hu SS, Holder-Hayes E, Day  
563 HR: **Tobacco product use among adults--United States, 2012-2013.** *MMWR Morb*  
564 *Mortal Wkly Rep* 2014, **63**(25):542-547.
- 565 22. Weaver SR, Majeed BA, Pechacek TF, Nyman AL, Gregory KR, Eriksen MP: **Use of**  
566 **electronic nicotine delivery systems and other tobacco products among USA adults,**  
567 **2014: results from a national survey.** *Int J Public Health* 2016, **61**(2):177-188.
- 568 23. **Tobacco Use Supplement to the Current Population Survey Harmonized Data,**  
569 **1992-2019** [<https://cancercontrol.cancer.gov/brp/tcrb/tus-cps/>]
- 570 24. Hyland A, Ambrose BK, Conway KP, Borek N, Lambert E, Carusi C, Taylor K, Crosse  
571 S, Fong GT, Cummings KM *et al*: **Design and methods of the Population Assessment**  
572 **of Tobacco and Health (PATH) Study.** *Tob Control* 2017, **26**(4):371-378.
- 573 25. Brener ND, Kann L, Shanklin S, Kinchen S, Eaton DK, Hawkins J, Flint KH:  
574 **Methodology of the Youth Risk Behavior Surveillance System--2013.** *MMWR*  
575 *Recomm Rep* 2013, **62**(Rr-1):1-20.
- 576 26. Corey CG, Holder-Hayes E, Nguyen AB, Delnevo CD, Rostron BL, Bansal-Travers M,  
577 Kimmel HL, Koblitz A, Lambert E, Pearson JL *et al*: **US Adult Cigar Smoking**  
578 **Patterns, Purchasing Behaviors, and Reasons for Use According to Cigar Type:**

579 **Findings From the Population Assessment of Tobacco and Health (PATH) Study,**  
580 **2013-2014.** *Nicotine Tob Res* 2018, **20**(12):1457-1466.

581 27. Persoskie A, O'Brien EK, Donaldson EA, Pearson J, Choi K, Kaufman A, Stanton CA,  
582 Delnevo CD: **Cigar package quantity and smoking behavior.** *BMC Public Health*  
583 2019, **19**(1):868.

584 28. **R: A language and environment for statistical computing.** **R Foundation for**  
585 **Statistical Computing, Vienna, Austria** [<https://www.R-project.org>]

586 29. Lumley T: **survey: analysis of complex survey samples.** In., R package 3.32 edn; 2017.

587 30. Lumley T: **Analysis of complex survey samples.** *Journal of Statistical Software* 2004,  
588 **9**(1):1-19.

589 31. McCarthy PJ: **Pseudoreplication: further evaluation and applications of the balanced**  
590 **half-sample technique.** *Vital Health Stat 2* 1969(31):1-24.

591 32. Judkins DR: **Fay's method for variance estimation.** *Journal of Official Statistics* 1990,  
592 **6**(3):223-239.

593 33. Sánchez-Romero LM, Cadham CJ, Hirschtick JL, Mattingly DT, Cho B, Fleischer NL,  
594 Brouwer A, Mistry R, Land SR, Jeon J *et al*: **A comparison of tobacco product**  
595 **prevalence by different frequency of use thresholds across three US surveys.** *BMC*  
596 *Public Health* 2021, **21**(1):1203.

597 34. Mantey DS, Omega-Njemnobi O, Montgomery L: **Flavored tobacco use is associated**  
598 **with dual and poly tobacco use among adolescents.** *Addict Behav* 2019, **93**:269-273.

599 35. Smith DM, Bansal-Travers M, Huang J, Barker D, Hyland AJ, Chaloupka F: **Association**  
600 **between use of flavoured tobacco products and quit behaviours: findings from a**  
601 **cross-sectional survey of US adult tobacco users.** *Tob Control* 2016, **25**(Suppl 2):ii73-  
602 ii80.

603 36. Hinds JT, 3rd, Li X, Loukas A, Pasch KE, Perry CL: **Flavored Cigars Appeal to**  
604 **Younger, Female, and Racial/Ethnic Minority College Students.** *Nicotine Tob Res*  
605 2018, **20**(3):347-354.

606 37. Friedman AS: **A Difference-in-Differences Analysis of Youth Smoking and a Ban on**  
607 **Sales of Flavored Tobacco Products in San Francisco, California.** *JAMA Pediatr*  
608 2021.

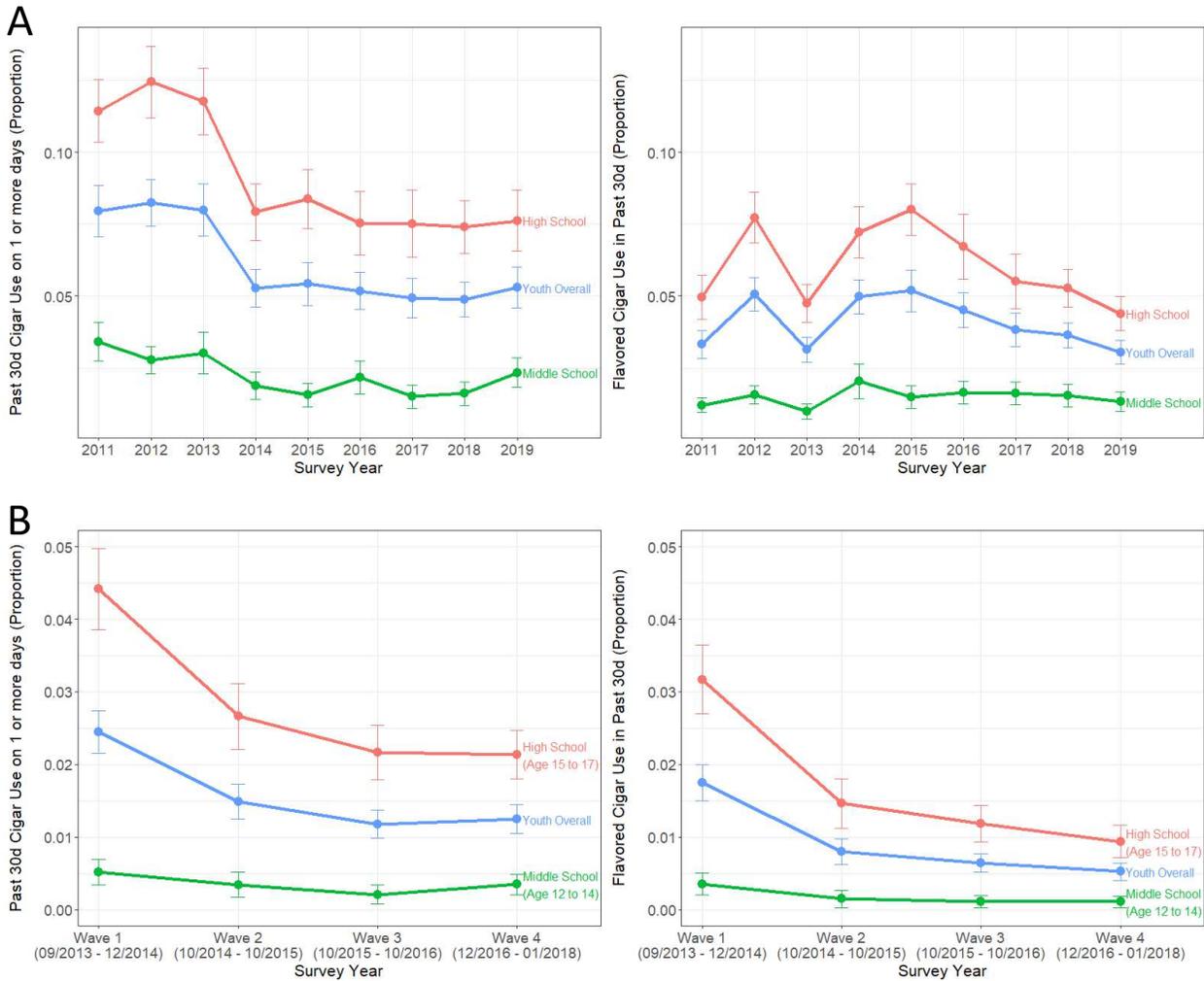
609 38. Du P, Bascom R, Fan T, Sinharoy A, Yingst J, Mondal P, Foulds J: **Changes in Flavor**  
610 **Preference in a Cohort of Long-Term Electronic Cigarette Users.** *Ann Am Thorac*  
611 *Soc* 2020, **17**(5):573-581.

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# 614 Figures

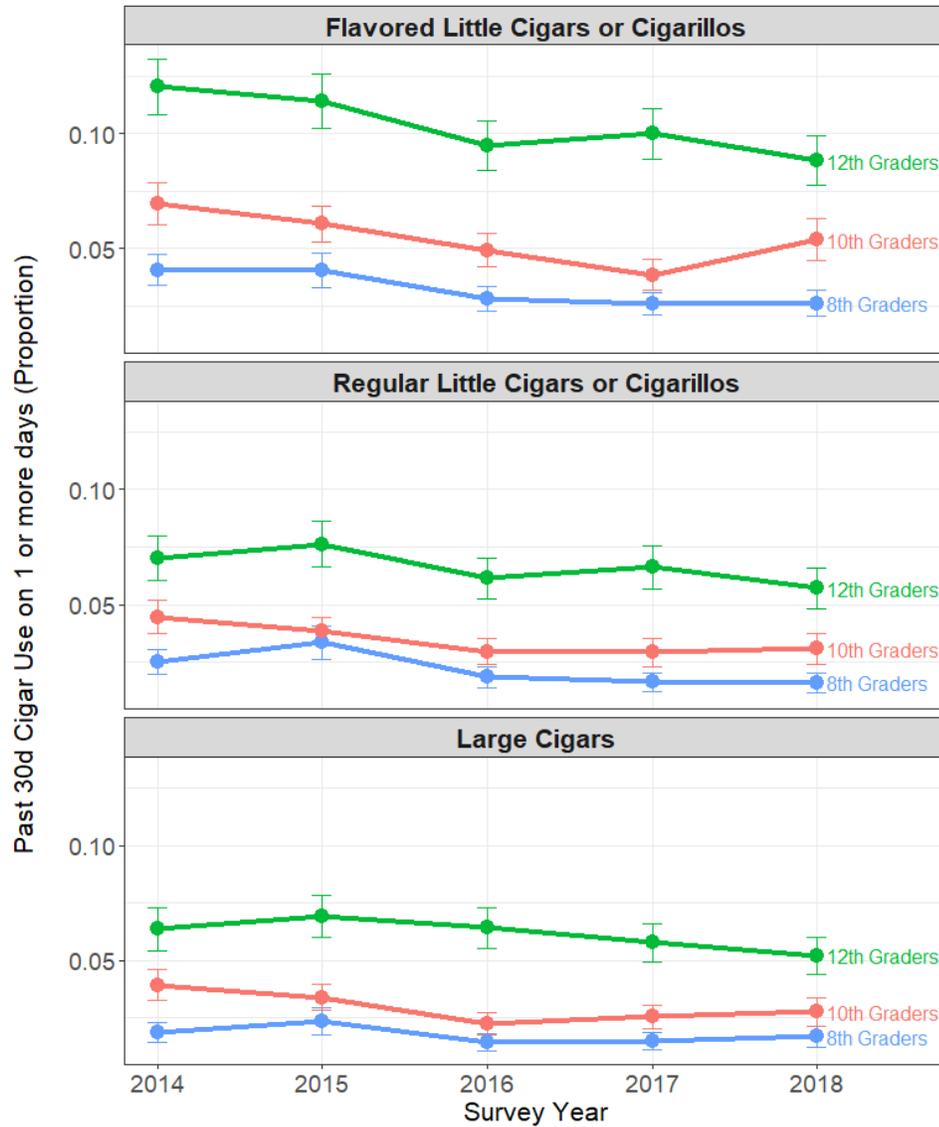
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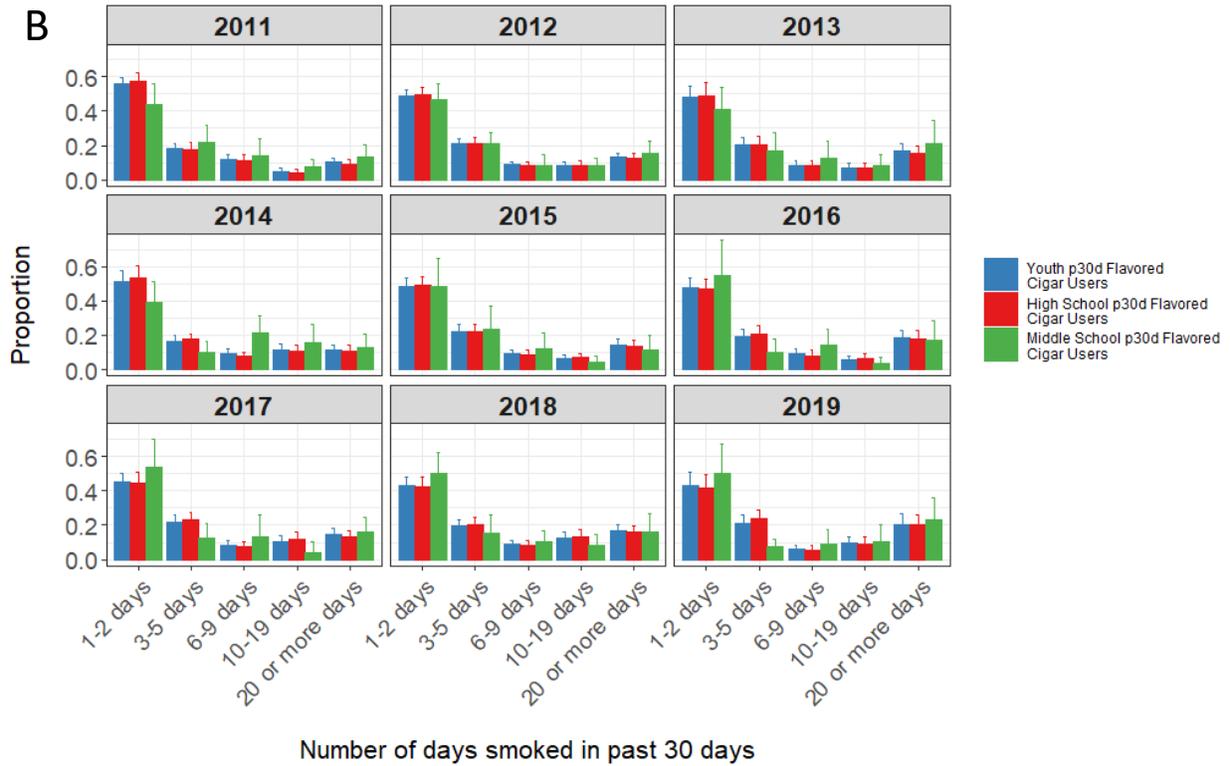
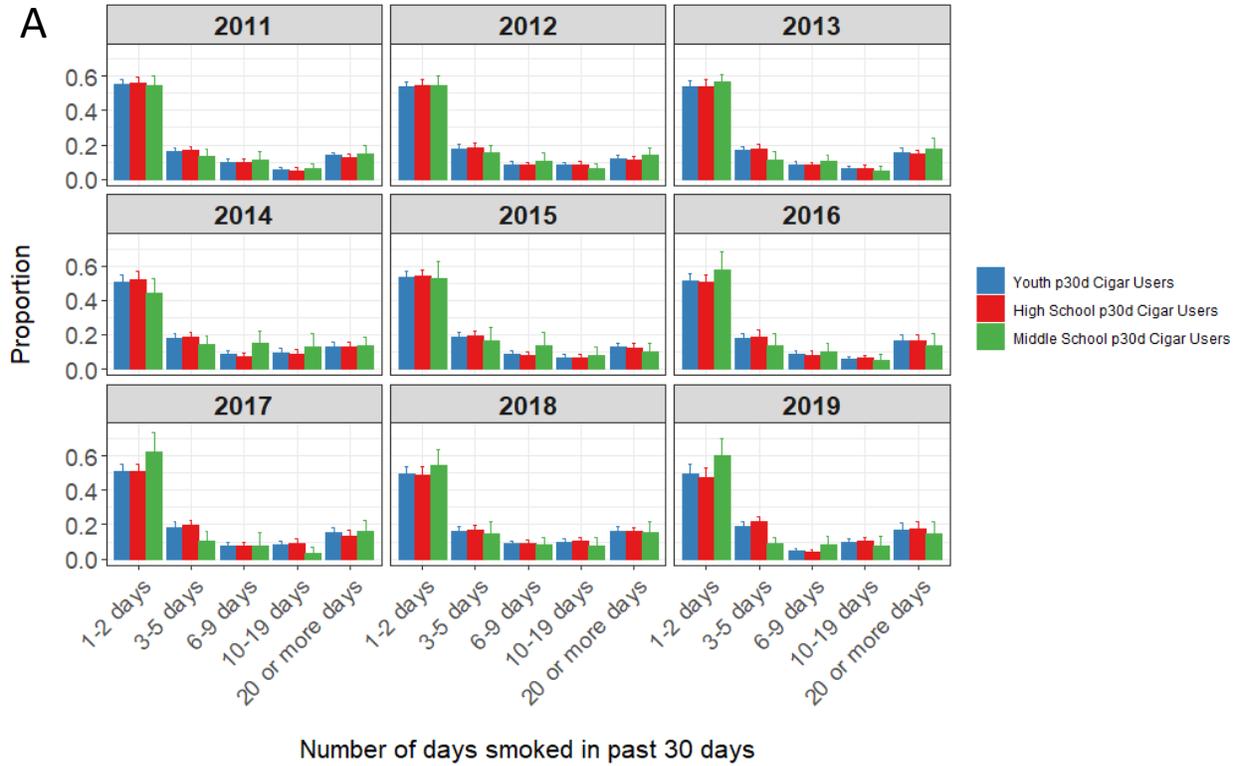
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618 Figure 1. Youth past 30-day use (on one or more days) of cigars overall (left) and flavored (right) based  
 619 on (A) NYTS and (B) PATH. Note that respondents to NYTS flavor-related questions were not limited to  
 620 those who responded affirmatively to indicate use of cigar products generally in the past 30 days. Also  
 621 note that the 2012 survey asked only if respondents used flavored tobacco products. In addition, the  
 622 2011 and 2013 survey asked only if respondents used flavored little cigars. This variation in question  
 623 content/format likely explains the estimate instability between 2011-2013.



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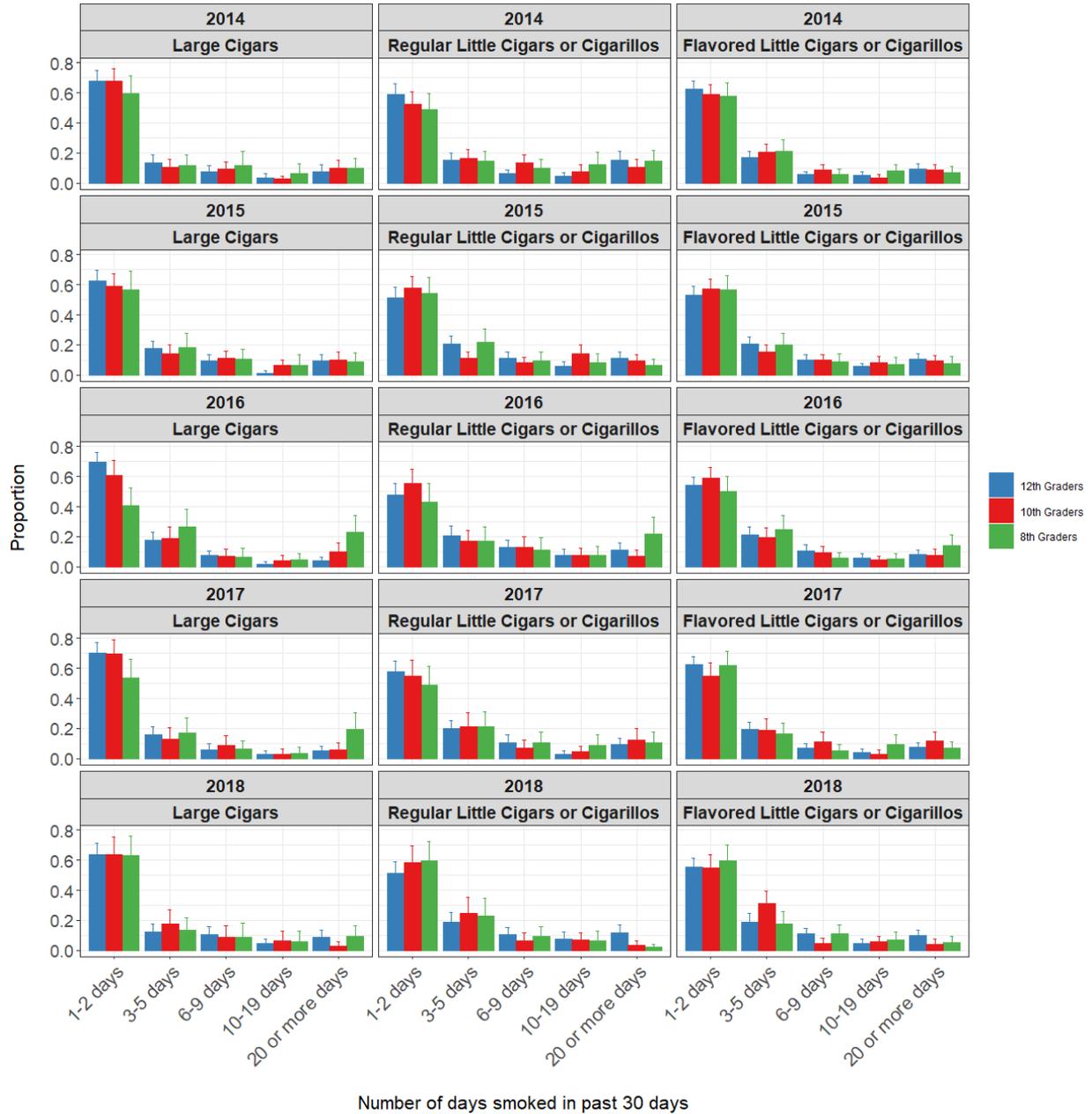
625 Figure 2. Past 30 day use of cigars based on youth respondents in MTF. Flavored little cigars/cigarillos  
 626 (top), “regular” little cigars/cigarillos (middle) and “large” cigars (bottom) are considered separately in  
 627 MTF. Note that the three usage groups are not mutually exclusive, and some respondents are  
 628 represented in multiple subgroups.



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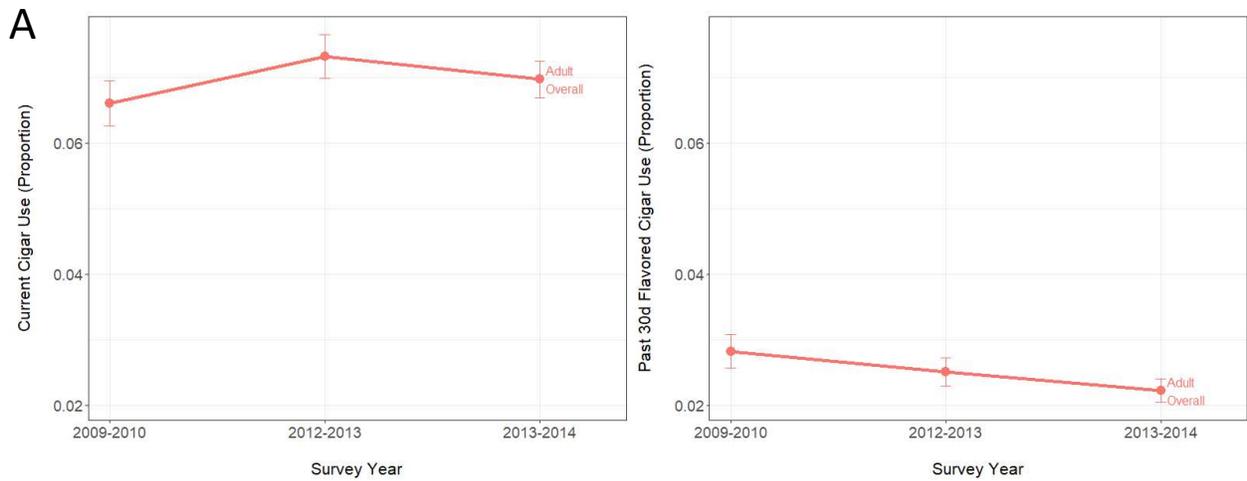
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Figure 3. Frequency of monthly use based on NYTS respondents (A) reporting cigar use overall in the past 30 days and (B) reporting flavored cigar use in the past 30 days.

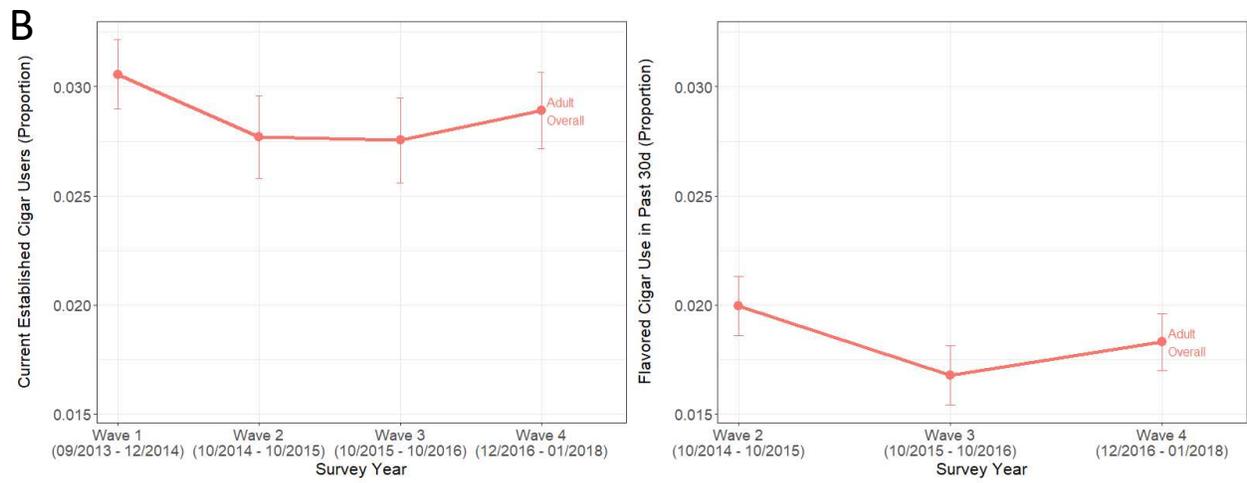


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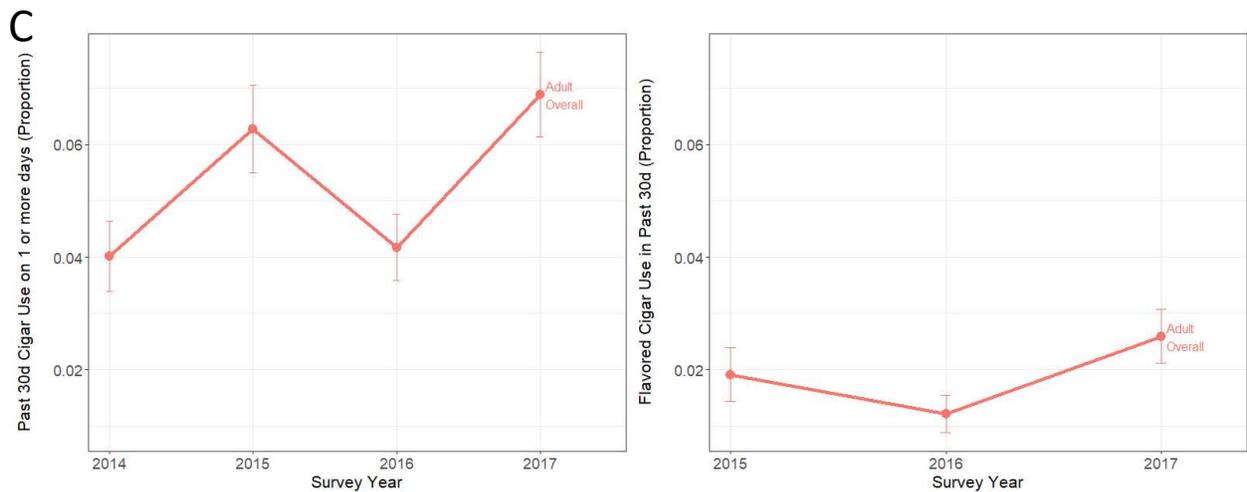
633 Figure 4. Frequency of monthly youth cigar use based on MTF respondents reporting cigar use in the  
 634 past 30 days. The plot is organized such that cigar type appears in individual columns (left, large cigars;  
 635 middle, regular little cigars or cigarillos; right, flavored little cigars or cigarillos) and survey year are  
 636 consistent per row (2014 at top through 2018 at bottom).



637

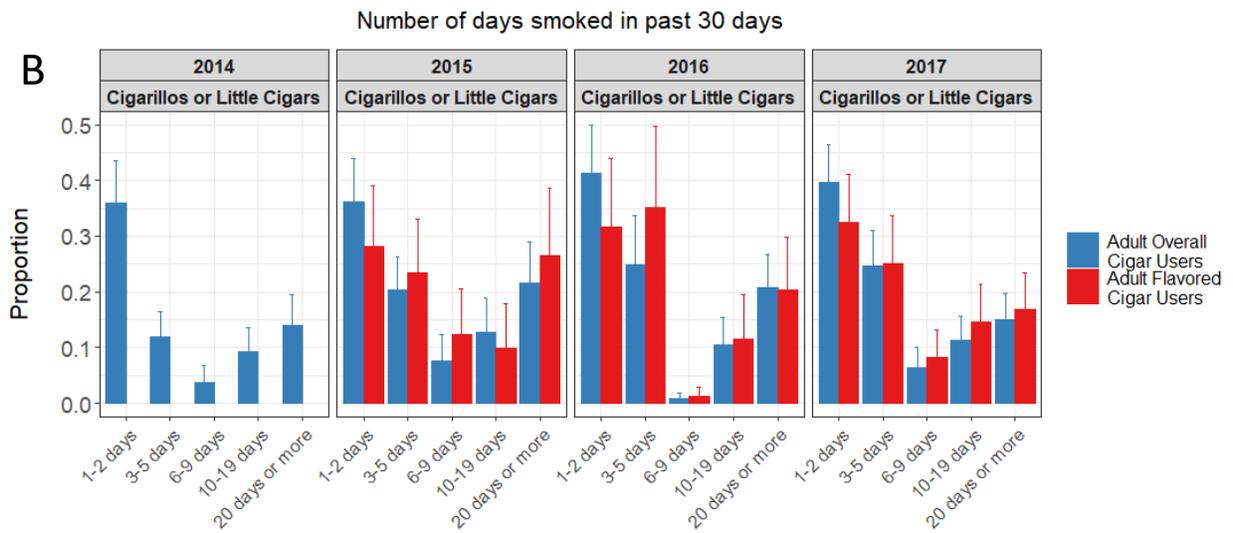
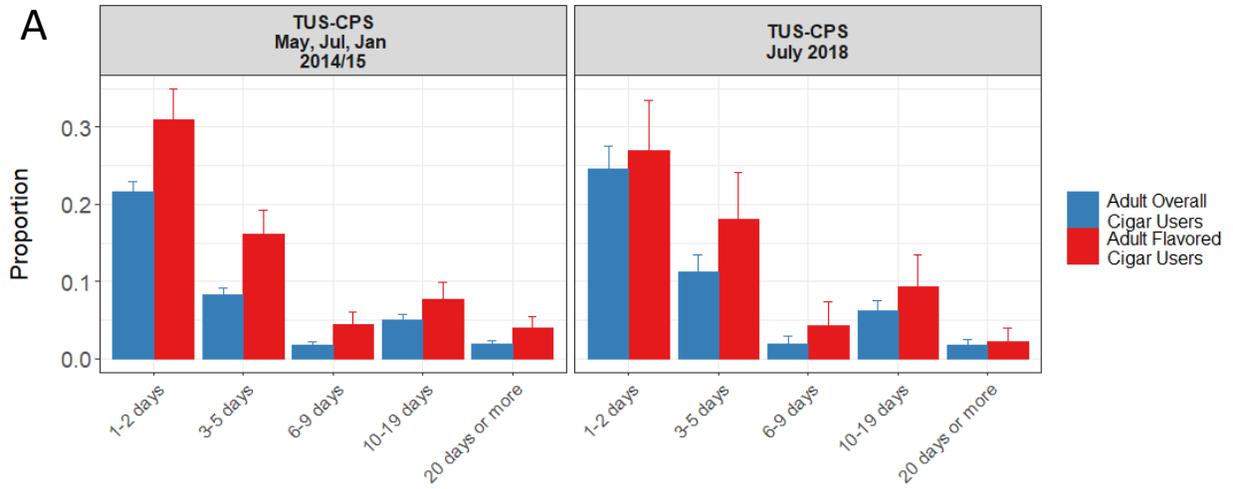


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640 Figure 5. Adult cigar use overall (left) and flavored cigar use specifically (right) based on (A) NATS (every  
 641 day, some days, or rarely in the past 30 days), (B) PATH (current established users), and (C) TPRPS (past  
 642 30-day use on one or more days). PATH Wave 1 and TPRPS 2014 did not ask specifically about current  
 643 flavored cigar use.



644

645

646

Figure 6. Frequency of adult cigar usage patterns based on (A) TUS-CPS (2014/15 – 2018) and (B) TPRPS (2014 – 2017).

647 **Tables**

648 Table 1. Brief description of nationally representative surveys/studies with applicability to the Research  
649 Question

<b>Survey/study name</b> <b>Years conducted</b>	<b>Description</b>
<b>Health Information National Trends Survey (HINTS)</b> 2003-present	HINTS is a biennial, cross-sectional survey of a nationally representative sample of American adults that is used to assess the impact of the health information environment. Specifically, HINTS measures how people access and use health information; how people use information technology to manage health and health information; and the degree to which people are engaged in healthy behaviors. In addition, several items in recent HINTS cycles that were administered in conjunction with FDA have a specific focus on tobacco use and risk perception. Survey results from these cycles are typically referred to as HINTS-FDA.
<b>Monitoring the Future (MTF)</b> 1975-present	MTF collects data annually on behaviors, attitudes and values of American youth and young adults. Each year, a nationally representative sample of 8 <sup>th</sup> , 10 <sup>th</sup> , and 12 <sup>th</sup> graders are surveyed, and a sample of participants receive follow-up surveys into young adulthood.
<b>National Adult Tobacco Survey (NATS)</b> 2009-present	The NATS provides data about tobacco use among adults, as well as the factors promoting, and impeding tobacco use.
<b>National Youth Tobacco Survey (NYTS)</b> 1999-present	The NYTS provides data about tobacco-related beliefs, attitudes, behaviors, and exposure to pro- and anti-tobacco influences from middle and high school youth.
<b>Population Assessment of Tobacco and Health Study (PATH)</b> 2013-present	The PATH Study is a national longitudinal study of tobacco use and health that surveys participants aged 12 and older.
<b>Tobacco Product and Risk Perception Survey (TPRPS)</b> 2014-present	The TPRPS assesses tobacco use, consumer reaction to tobacco product marketing, and individual perception of the risk of tobacco products, specifically novel and alternative products. The most recent iteration of the survey was completed in 2017.
<b>Tobacco Use Supplement to Current Population Survey (TUS-CPS)</b> 1992-present	The TUS-CPS is a survey of tobacco use that is administered every 3 to 4 years. Data are available from adults in all waves and from youth aged 15-17 from years 1992-2006.

650

651 Table 2. Individual datasets acquired for each nationally representative survey/study identified for  
 652 analysis.

<b>Survey/study name</b>	<b>Years conducted</b>	<b>Dataset Name</b>	<b>Data Access/URL</b>
<b><i>Data on Youth Users</i></b>			
<b>Monitoring the Future (MTF)</b>	1975-present	2014 – 2018 Annual Survey of 8 <sup>th</sup> and 10 <sup>th</sup> Graders  2014 – 2018 Annual Survey of 12 <sup>th</sup> Graders	<a href="https://www.icpsr.umich.edu/web/N AHDAP/series/35">https://www.icpsr.umich.edu/web/N AHDAP/series/35</a>
<b>National Youth Tobacco Survey (NYTS)</b>	1999-present	2011 – 2019 Annual Survey of Middle and High School Students	<a href="https://www.cdc.gov/tobacco/data_statistics/surveys/nyts/data/index.html">https://www.cdc.gov/tobacco/data_statistics/surveys/nyts/data/index.html</a>
<b>Population Assessment of Tobacco and Health Study (PATH)</b>	2013-present	Wave 1 (09/2013 – 12/2014) Youth Wave 2 (10/2014 – 10/2015) Youth Wave 3 (10/2015 – 10/2016) Youth Wave 4 (12/2016 – 01/2018) Youth	<a href="https://www.icpsr.umich.edu/web/N AHDAP/studies/36498">https://www.icpsr.umich.edu/web/N AHDAP/studies/36498</a>
<b><i>Data on Adult Users</i></b>			
<b>Health Information National Trends Survey (HINTS)</b>	2015, 2017	HINTS FDA 2015  HINTS FDA Cycle 2 2017	<a href="https://hints.cancer.gov/data/download-data.aspx">https://hints.cancer.gov/data/download-data.aspx</a>
<b>National Adult Tobacco Survey (NATS)</b>	2009-2014	2009/10 NATS Survey  2012/13 NATS Survey  2013/14 NATS Survey	<a href="https://www.cdc.gov/tobacco/data_statistics/surveys/nats/index.html">https://www.cdc.gov/tobacco/data_statistics/surveys/nats/index.html</a>
<b>Population Assessment of Tobacco and Health Study (PATH)</b>	2013-present	Wave 1 (09/2013 – 12/2014) Adult Wave 2 (10/2014 – 10/2015) Adult Wave 3 (10/2015 – 10/2016) Adult Wave 4 (12/2016 – 01/2018) Adult	<a href="https://www.icpsr.umich.edu/web/N AHDAP/studies/36498">https://www.icpsr.umich.edu/web/N AHDAP/studies/36498</a>
<b>Tobacco Product and Risk Perception Survey (TPRPS)</b>	2014-2017	2014 GSU TCORS TPRPS Survey 2015 GSU TCORS TPRPS Survey 2016 GSU TCORS TPRPS Survey 2017 GSU TCORS TPRPS Survey	via Data Sharing Agreement with the Georgia State University Tobacco Center of Regulatory Science (TCORS)
<b>Tobacco Use Supplement to Current Population Survey (TUS-CPS)</b>	2010-2018	2014/2015 TUS-CPS Survey July 2018 TUS-CPS Survey	<a href="https://cancercontrol.cancer.gov/brp/tcrb/tus-cps/questionnaires-data">https://cancercontrol.cancer.gov/brp/tcrb/tus-cps/questionnaires-data</a>

654 Table 3. Prior wave flavored adult cigar use predicting established use of cigarettes in subsequent wave  
 655 in PATH.

Cigar Type	Flavored Cigar Use in Wave 2?	Record Count (n)	Prevalence (95% CI)	OR (95% CI)	AOR (95% CI)
<b>Wave 3 Cigarette Use by Wave 2 Past 30 day Flavored Cigar Use in Wave 2 Cigarette Nonsmokers†</b>					
Cigarillos	No	10	9.424 (3.14, 15.71)	Reference	Reference
	Yes	12	10.61 (4.658, 16.56)	1.14 (0.394, 3.3)	0.914 (0.23, 3.63)
	I don't know	1	13.73 (0, 41.51)	1.53 (0.0886, 26.4)	1.37 (0.0517, 36.4)
Filtered Cigars	No	8	25.08 (4.777, 32.56)	Reference	Reference
	Yes	15	23.63 (12.25, 30.93)	0.924 (0.3, 2.85)	0.806 (0.172, 3.77)
	I don't know	1	37.6 (0, 43.48)	1.8 (0.0533, 60.8)	4.44 (0.109, 181)
Traditional Cigars	No	8	4.747 (1.237, 8.257)	Reference	Reference
	Yes	6	10.27 (1.141, 19.41)	2.3 (0.572, 9.23)	0.636 (0.083, 4.88)
	I don't know	1	13.02 (0, 40.63)	3 (0.199, 45.2)	3.49 (0.0213, 572)
<b>Wave 4 Cigarette Use by Wave3 Past 30 day Flavored Cigar Use in Wave 3 Cigarette Nonsmokers‡</b>					
Cigarillos	No	14	10.31 (4.073, 16.55)	Reference	Reference
	Yes	14	15 (7.288, 22.72)	1.54 (0.598, 3.94)	1.46 (0.505, 4.24)
	I don't know	0	0 (0, 0)	NA*	NA*
Filtered Cigars	No	8	15.85 (3.736, 25.96)	Reference	Reference
	Yes	11	19.81 (9.185, 31.88)	1.31 (0.36, 4.78)	1.48 (0.233, 9.35)
	I don't know	1	20.84 (-10.39, 28.91)	1.4 (0.089, 22)	0.922 (0.00724, 118)
Traditional Cigars	No	8	2.868 (0.6246, 5.111)	Reference	Reference
	Yes	3	5.827 (0, 12.14)	2.1 (0.417, 10.5)	0.948 (0.0913, 9.86)
	I don't know	0	0 (0, 0)	NA*	NA*

Abbreviations: AOR=adjusted odds ratio, CI=confidence interval, NA=Not Applicable, OR=odds ratio.

\*Valid odds ratios cannot be calculated when zero relevant records are included in the data.

†Wave 2 non-cigarette smoking cigarillo, filtered cigar, and traditional cigar users were represented by 273, 115, and 308 total records, respectively (of which 134, 69, and 79 also indicated use of flavored cigars).

‡Wave 3 non-cigarette smoking cigarillo, filtered cigar, and traditional cigar users were represented by 255, 115, and 320 total records, respectively (of which 107, 60, and 56 also indicated use of flavored cigars).

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657 Table 4. Wave 2 flavored cigar use predicting transitions to daily or non-current Wave 3 cigar use  
 658 among wave 2 regular but not daily (i.e., “some day”) adults in PATH.

Wave 2 Cigar Type	Flavored Cigar Use in Wave 2?	Wave 3 Cigar Use Frequency	Record Count (n)	Prevalence (95% CI)	OR (95% CI)	AOR (95% CI)
Cigarillos*	No	Every day	11	5.284 (1.773, 8.795)	Reference	Reference
		Some day	75	41.88 (34.08, 49.68)	--	--
		Non-current	95	52.83 (44.75, 60.91)	Reference	Reference
	Yes	Every day	16	8.552 (3.56, 13.54)	1.68 (0.606, 4.63)	1.89 (0.557, 6.4)
		Some day	104	40.75 (32.98, 48.52)	--	--
		Non-current	125	50.7 (42.69, 58.71)	0.918 (0.586, 1.44)	0.796 (0.472, 1.34)
	I don't know	Every day	1	14.33 (-13.82, 42.48)	3 (0.182, 49.5)	3.83 (0, Inf)
		Some day	1	9.826 (-12.12, 31.77)	--	--
		Non-current	7	75.84 (42.97, 100)	2.8 (0.326, 24.1)	2.15 (0.227, 20.3)
Filtered Cigar†	No	Every day	10	12.82 (3.782, 21.85)	Reference	Reference
		Some day	34	40.19 (29.13, 51.24)	--	--
		Non-current	32	46.99 (35.49, 58.5)	Reference	Reference
	Yes	Every day	16	13.6 (6.79, 20.41)	1.07 (0.392, 2.92)	1.26 (0.337, 4.7)
		Some day	48	36.62 (25.24, 48)		
		Non-current	60	49.78 (38.58, 60.97)	1.12 (0.582, 2.15)	1.28 (0.588, 2.8)
	I don't know	Every day	1	24.19 (-28.49, 76.86)	2.17 (0.0669, 70.4)	9.09 (0.0505, 1,635)
		Some day	1	31.89 (-4.706, 68.48)		
		Non-current	2	43.93 (6.031, 81.82)	0.884 (0.144, 5.4)	1.05 (0.168, 6.56)
Traditional Cigar‡	No	Every day	11	3.815 (1.445, 6.185)	Reference	Reference
		Some day	179	81.74 (76.34, 87.13)	--	--
		Non-current	41	14.45 (9.515, 19.38)	Reference	Reference
	Yes	Every day	4	5.362 (-0.788, 11.51)	1.43 (0.276, 7.39)	0.751 (0.0952, 5.93)
		Some day	47	66.21 (56.17, 76.24)	--	--
		Non-current	25	28.43 (17.59, 39.28)	<b>2.35 (1.3, 4.27)</b>	1.28 (0.584, 2.8)
	I don't know	Every day	2	13.02 (-9.024, 35.07)	3.78 (0.43, 33.2)	4.41 (0.365, 53.3)
		Some day	3	35.11 (-3.182, 73.4)	--	--
		Non-current	3	51.87 (8.842, 94.9)	6.38 (0.859, 47.4)	4.89 (0.26, 91.9)

Abbreviations: AOR=adjusted odds ratio, CI=confidence interval, OR=odds ratio.

Statistically significant finding indicated in bold.

\*Wave 2 some day cigarillo users were represented by 572 total records (of which 273 also indicated use of flavored cigars).

†Wave 2 some day filtered cigar users were represented by 260 total records (of which 137 also indicated use of flavored cigars).

‡Wave 2 some day traditional cigar users were represented by 452 total records (of which 121 also indicated use of flavored cigars).

660 Table 5. Wave 3 flavored cigar use predicting transitions to daily or non-current Wave 4 cigar use  
 661 among Wave 3 regular but not daily (i.e., “some day”) adult users in PATH.

Wave 3 Cigar Type	Flavored Cigar Use in Wave 3?	Wave 4 Cigar Use Frequency	Record Count (n)	Prevalence (95% CI)	OR (95% CI)	AOR (95% CI)
Cigarillo <sup>†</sup>	No	Every day	16	9.353 (3.742, 14.96)	Reference	Reference
		Some day	69	48.74 (40.53, 56.96)	--	--
		Non-current	64	41.91 (33.76, 50.05)	Reference	Reference
	Yes	Every day	10	4.313 (0.9084, 7.718)	0.437 (0.152, 1.26)	0.372 (0.126, 1.1)
		Some day	99	52.41 (44.15, 60.68)	--	--
		Non-current	88	43.27 (34.91, 51.63)	1.06 (0.65, 1.72)	0.946 (0.538, 1.66)
	I don't know	Every day	3	9.771 (0, 20.35)	1.05 (0.228, 4.82)	1.1 (0.127, 9.53)
		Some day	7	36.58 (13.63, 59.52)	--	--
		Non-current	9	53.65 (27.4, 79.91)	1.6 (0.514, 5.01)	1.36 (0.418, 4.41)
Filtered Cigars <sup>‡</sup>	No	Every day	10	12.37 (3.086, 21.65)	Reference	Reference
		Some day	29	46.52 (28.66, 64.38)	--	--
		Non-current	36	41.11 (26.96, 55.26)	Reference	Reference
	Yes	Every day	7	7.422 (1.117, 13.73)	0.568 (0.147, 2.19)	0.479 (0.062, 3.69)
		Some day	33	38.94 (25.93, 51.95)	--	--
		Non-current	50	53.64 (40.92, 66.35)	1.66 (0.812, 3.38)	1.71 (0.69, 4.24)
	I don't know	Every day	0	--	NA*	NA*
		Some day	3	47.87 (0, 100)	--	--
		Non-current	3	52.13 (0, 100)	1.56 (0.134, 18.1)	0.789 (0.105, 5.95)
Traditional Cigars <sup>§</sup>	No	Every day	10	6.449 (0.5351, 12.36)	Reference	Reference
		Some day	164	72.81 (65.25, 80.38)	--	--
		Non-current	48	20.74 (14.54, 26.93)	Reference	Reference
	Yes	Every day	5	3.632 (0, 8.695)	0.547 (0.0761, 3.93)	0.575 (0.0931, 3.55)
		Some day	41	61.33 (48.4, 74.27)	--	--
		Non-current	28	35.03 (23.64, 46.43)	<b>2.06 (1.07, 3.96)</b>	1.28 (0.552, 2.96)
	I don't know	Every day	0	--	NA*	NA*
		Some day	7	31.4 (0, 70.15)	--	--
		Non-current	5	68.6 (29.85, 100)	8.35 (1.45, 48.2)	7.73 (0.918, 65.1)

Abbreviations: AOR=adjusted odds ratio, CI=confidence interval, NA=Not Applicable, OR=odds ratio.

Statistically significant finding indicated in bold.

\*Valid odds ratios cannot be calculated when zero relevant records are included in the data.

<sup>†</sup>Wave 3 some day cigarillo users were represented by 475 total records (of which 217 also indicated use of flavored cigars).

<sup>‡</sup>Wave 3 some day filtered cigar users were represented by 226 total records (of which 109 also indicated use of flavored cigars).

<sup>§</sup>Wave 3 some day traditional cigar users were represented by 456 total records (of which 108 also indicated use of flavored cigars).

663 Table 6. Prevalence of current cigarette smoking in youth cigar users of flavored or unflavored products  
 664 in PATH.

Flavored Cigar Use?	PATH Wave	Cigarillos		Filtered Cigars		Traditional Cigars	
		Record Count (n)	Prevalence (95%CI)	Record Count (n)	Prevalence (95%CI)	Record Count (n)	Prevalence (95%CI)
<b>Yes†</b>	<b>1</b>	131	58.42 (50.9, 65.93)	34	68.51 (51.73, 85.29)	31	56.48 (39.96, 73.01)
	<b>2</b>	34	51.06 (36.38, 65.74)	17	61.49 (38.53, 84.44)	19	58.39 (40.87, 75.91)
	<b>3</b>	34	64.01 (48.53, 79.49)	17	63.04 (36.11, 89.97)	10	55.89 (27.03, 84.75)
	<b>4</b>	41	61.95 (48.83, 75.08)	13	68.4 (47.77, 89.02)	9	73.11 (45.65, 100)
<b>No‡</b>	<b>1</b>	36	49.83 (37.71, 61.95)	14	76.8 (53.27, 100)	21	46.83 (28.86, 64.8)
	<b>2</b>	25	56.44 (40.71, 72.17)	15	87.19 (66.75, 100)	20	49.63 (29.62, 69.65)
	<b>3</b>	13	57.09 (36.04, 78.14)	14	92.12 (76.28, 100)	7	52.85 (23, 82.7)
	<b>4</b>	26	55.2 (41.28, 69.12)	10	55.11 (27.4, 82.82)	13	53.49 (30.24, 76.74)
<b>I don't know§</b>	<b>1*</b>	--		--		--	
	<b>2</b>	6	42.55 (14.39, 70.7)	5	79.65 (48.35, 100)	2	29.69 (-7.742, 67.11)
	<b>3</b>	7	62.59 (31.5, 93.69)	3	70.17 (20.87, 100)	2	68.33 (12.16, 100)
	<b>4</b>	10	39.76 (19.2, 60.32)	2	31.91 (-10.16, 73.99)	4	29.81 (2.997, 56.62)

\*The response of "I don't know" to flavored cigar use questions was not enabled as a third possible option in Wave 1 data collection.

†Flavored cigarillo users were represented by 217, 61, 53, and 66 total records in Waves 1 through 4, respectively. Flavored filtered cigar users were represented by 48, 25, 25, and 19 total records in Waves 1 through 4, respectively. Flavored traditional cigar users were represented by 48, 31, 16, and 13 total records in Waves 1 through 4, respectively.

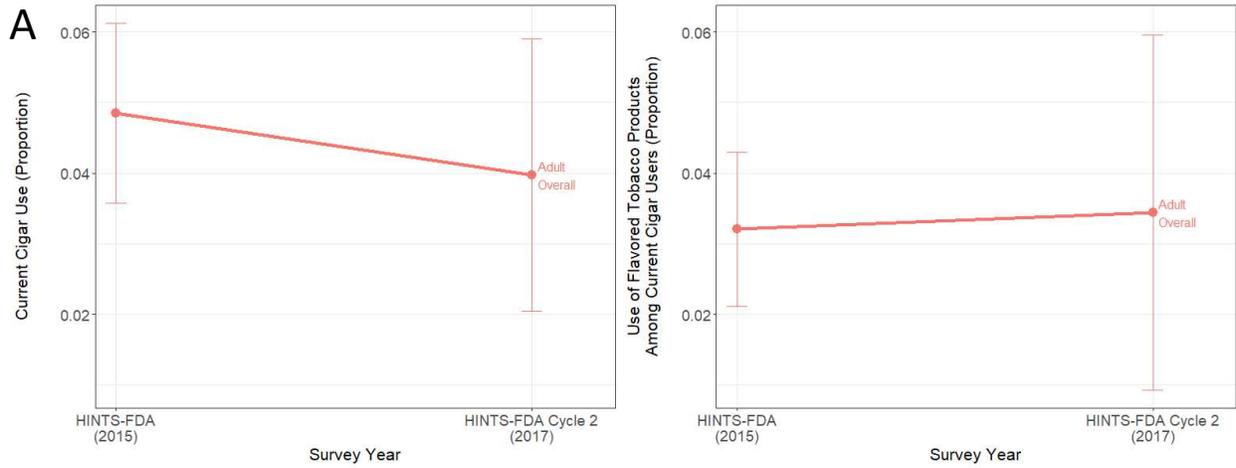
‡Unflavored cigarillo users were represented by 72, 43, 24, and 50 total records in Waves 1 through 4, respectively. Unflavored filtered cigar users were represented by 18, 17, 15, and 17 total records in Waves 1 through 4, respectively. Unflavored traditional cigar users were represented by 43, 35, 13, and 24 total records in Waves 1 through 4, respectively.

§Cigarillo users unsure whether product was flavored were represented by 16, 12, and 27 total records in Waves 2 through 4, respectively. Filtered cigar users unsure whether product was flavored were represented by 7, 4, and 7 total records in Waves 2 through 4, respectively. Traditional cigar users unsure whether product was flavored were represented by 8, 3, and 10 total records in Waves 2 through 4, respectively.

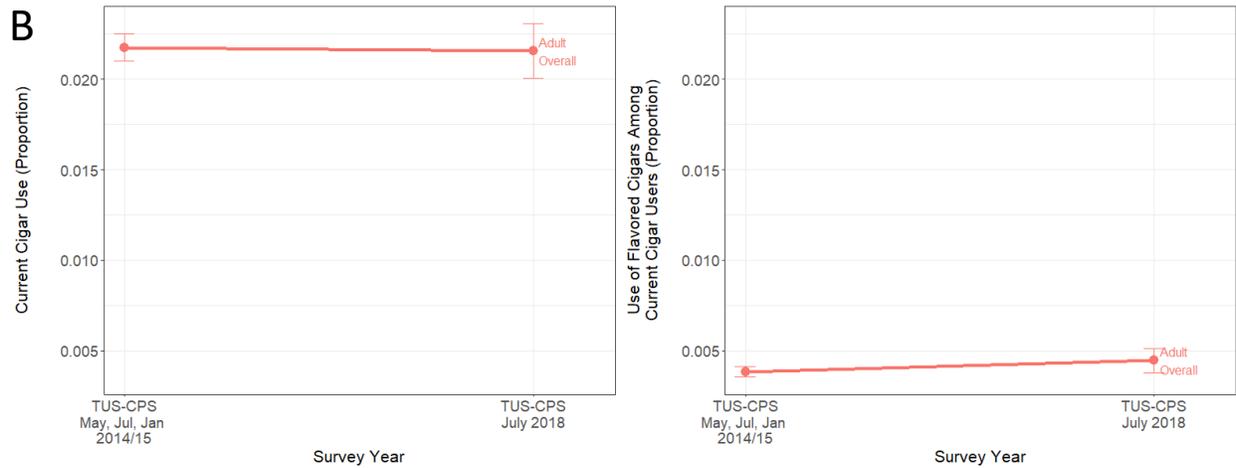
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667 **Additional Files**



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670 Supplementary Figure 1. Adult cigar use overall (left) and flavored cigar use specifically (right) based on  
 671 (A) HINTS-FDA (current every day or some day users) and (B) TUS-CPS (past 30-day use on one or more  
 672 days). Note that these HINTS-FDA estimates reflect use of any flavored tobacco product (including e-  
 673 cigarette/vaping products whose popularity grew considerably during this timespan). The HINTS-FDA  
 674 survey question does not ask specifically about use of flavored cigars.